



FAA-E-2253c  
6 MAY 1969  
SUPERSEDING  
FAA-E-2253b, 4/15/68

## DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION SPECIFICATION

### BYPASS SWITCHBOARD, 3,000 AMPERE, 480 VOLT, 3 PHASE

#### 1. SCOPE AND CLASSIFICATION

1.1 Scope.-This specification sets forth the requirements for a bypass switchboard for use in diverting commercial power around an existing automatic transfer switchboard, which serves two 550 KW engine generators and four loads, thus deenergizing the transfer switchboard for servicing.

1.2 Classification.-The bypass switchboards furnished under this specification shall be of one of the following two types:

Type I - The bus connections shall be arranged as shown on Figure 1, i.e., the commercial power entrance shall be on the left-hand side of the top as viewed from the front of the cabinet, and the outlet on the right-hand side of the top.

Type II - The bus connections shall be reversed to that shown for Type I.

#### 2. APPLICABLE DOCUMENTS

2.1 FAA documents.- The following FAA specification and standards of the issues specified in the invitation for bids or request for proposals form a part of this specification.

2.2 Military and Federal publications.- The following Military and Federal publications, of the issues in effect on the date of the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein.

2.2.1 Military specification

MIL-E-17555	Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of
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2.2.2 Military Standard

MIL-STD-129	Marking for Shipment and Storage
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2.2.3 Federal specifications

QQ-B-825	Bus Bar; Copper, Aluminum, or Aluminum - Alloy
TT-E-489	Enamel, Alkyd, Gloss

2.2.4 Federal standards

FED-STD-102	Preservation, Packaging and Packing Levels
FED-STD-595	Colors

2.3 Other publications.- The following publications, of the issues in effect on the date of the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein.

National Fire Protection Association Handbook No. 70	National Electrical Code
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National Electrical Manufacturers Association No. SG5	Power Switchgear Assemblies
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Administration Office issuing the invitation for bids or requests for material. Requests should fully identify material desired, i.e., specification and drawing numbers and dates. Requests should cite the invitation for bids, requests for proposals, or the contract involved or other use to be made of the requested material.)

(Information on obtaining copies of Federal specifications and standards may be obtained from General Services Administration offices in Washington, D. C., Denver, Seattle, San Francisco, Kansas City, Mo., Chicago, Atlanta, New York, Boston, Dallas and Los Angeles.)

(Single copies of Military specifications and standards may be obtained from Federal Aviation Administration, Washington, D. C. 20590, ATTN: Contracting Officer. Requests should cite the invitation for bids, request for proposals, or contract for which the material is needed. Mail requests, if found acceptable, will be forwarded to a Military supply depot for filling; hence, ample time should be allowed.)

(Information on obtaining copies of NEMA specifications may be obtained from National Electrical Manufacturers Association, 155 East 44th Street, New York, New York 10017.)

(Information on obtaining copies of National Electrical Code may be obtained from National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts 02110.)

(Information on obtaining copies of USA Standards may be obtained from United States of America Standards Institute, 10 East 40th Street, New York, New York, 10017.)

### 3. REQUIREMENTS

3.1 General.- The bypass switchboard shall be complete in accordance with all specification requirements and comply with NEMA Standard SG5. Components of the unit offered must be new and the products of recognized manufacturers regularly engaged in making such components. All components shall be utilized in a manner compatible with the component manufacturer's recommendations. The assembly shall be housed in a NEMA 1 metal free-standing cabinet which will be installed over a cable trench. The bypass switchboard shall basically consist of five separate 3 phase switching devices that require operation in a given sequence with space for two auxiliary

switchboard. The design and construction of the bypass switchboard shall be in conformance with the requirements of the National Electrical Code.

3.1.2 Workmanship.- All parts of the bypass switchboard shall be carefully made, sturdily constructed, and free from structural, electrical, mechanical and other defects which would adversely affect long life in service.

3.1.3 Interchangeability.- Bypass switchboard assemblies of the same rating furnished under this specification on a given contract shall be identical with each other, and all parts of one assembly shall be interchangeable with corresponding parts of the other assemblies.

3.1.4 Maintainability.- All equipment including the switches, circuit breakers, and bus work shall be arranged within the cabinet in such a manner that maintenance can be performed on the equipment through the front and rear doors without simultaneously deenergizing both the essential and nonessential loads. This requires reasonable access for cleaning of all buses and insulators, tightening of bolts on switches, bus work, cable lugs, and supporting structure; as well as a capability of checking and servicing of all parts and repairing and replacement of circuit breakers and switch parts. Maintenance procedures which require opening of both 1200 ampere breakers for a period not to exceed 2 minutes will be acceptable. Special handtools, or insulating barriers which are required to perform maintenance functions shall be furnished with the switchboard. Special handtools shall be understood to be those not normally available from a tool supply house.

### 3.2 Service conditions

3.2.1 Voltage.- The design center system operating voltage will be 277/480, 3 phase, 4 wire (solid neutral) at 60 Hz. All AC components shall comply with specified performance requirements throughout the stated environmental conditions at any voltage within  $\pm 10\%$  of the design center value and at frequencies  $\pm 3$  Hz. Components designed for operating on 48 volts DC shall comply with specified performance requirements throughout the stated environmental conditions at any voltage between 44 and 52 volts.

3.2.2 Environmental conditions.- Specified performance requirements shall be met throughout the following range of environmental conditions:

Elevation	0 to 6000 feet
Temperature	+10°C to 50°C
Relative Humidity	5% to 90%

switching devices "4" and "5" shall be closed.

3.3.3 Switching sequence.- During the operation of the switching devices from the NORMAL to the BYPASS position and from the BYPASS position to the NORMAL position there shall be no interruption in commercial power to the load terminals. This shall be accomplished by an overlapping sequence of operation by the switching devices. In switching from the NORMAL position to the BYPASS position switching devices "4" and "5" shall close before switching devices "1," "2" and "3" open. In switching from the BYPASS position to the NORMAL position switching devices "1," "2" and "3" shall close before switching devices "4" and "5" open.

During operation of the bypass switchboard a warning device such as a buzzer shall be included in the circuitry to indicate that switching has not been completed, (i.e., in going into BYPASS, the first operation would be the closing of switching devices "4" and "5" which would turn the buzzer on. The second operation would be the opening of switching devices "1," "2" and "3" which would turn the buzzer off. When returning to NORMAL the buzzer shall again indicate whether switching has been completed.) Leads for an external relay in parallel with the buzzer shall be brought to the terminal block for external circuits. The relay will be used to prevent engine starting during switching.

3.3.4 Switching method.- Operation of the switches and circuit breakers shall be by electrical means utilizing a 48 volt DC source furnished by others. The source will be lead acid batteries having a capacity of approximately 60 ampere hours at the 8 hour rate. Bypassing or returning to NORMAL shall be accomplished by the operation of either push buttons or a rotary switch. Except for the 1200 ampere auxiliary circuit breakers (3.6) tripping devices for circuit breakers shall not be located on the front of the switchboard. In order to obtain a high level of reliability the control circuits should be as simple and direct as possible, and utilize rugged dependable components. It shall be possible to operate the switchboard manually in case of an emergency.

3.4 Switching device characteristics.- Switching devices "1", "2" and "3" shall be 3 phase and each have a rating of 3,000 amperes. Drawout type circuit breakers with the overload protection removed may be used in this application. Switches "1", "2" and "3" shall have high contact pressure to handle the available short circuit currents long enough for circuit protective devices to operate. They shall have a withstand current rating of 80,000 amperes symmetrical at 480 VAC for 10 cycles duration.

that the green, red, and blue pilot lamps may operate on the DC source provided they consume not more than 4 watts each. Loss of the 48 volt source shall not cause any switching change.

3.5 Interlocks.- Switches 1, 2 and 3 shall be mechanically interlocked to insure simultaneous operation and shall be interlocked mechanically or electrically or both with switching devices "4" and "5" to prevent an interruption of commercial power to the loads. Where electrical interlocking is used, the system shall fail safe if there is a continuity failure in the interlock circuits. To prevent paralleling of the generators with each other or with commercial power, interlock circuitry, connected to terminals at the rear of the cabinet, shall be provided for connection to an external circuit which when open will preclude the operation of the switching devices 1, 2, 3, 4 and 5 from NORMAL to the BYPASS position or from the BYPASS to the NORMAL position.

Interlock circuitry shall be included which shall function when the bypass switch is in the NORMAL position to prevent closure of either of the 1200 ampere breakers (paragraph 3.6) unless the other 1200 ampere breaker is open. This interlock function shall not prevent both 1200 ampere breakers being closed when the bypass switch is in the BYPASS position.

3.6 Auxiliary circuit breakers.- When called for in the contract schedule, two 1200 ampere drawout type air circuit breakers, having a rated interrupting capacity of not less than 50,000 amperes symmetrical, shall be provided mounted in space provided in the bypass switchboard cabinet and wired as shown in Figure 1. The breakers shall have overcurrent tripping devices of the long and short delay type to give selectivity. In both breakers, the long-time delay device shall be adjusted to trip the breaker in 10 seconds at 150% of rated load (1800 amperes), and the short-time delay device shall trip the breaker in approximately 14 cycles at 1,000% of rated load.

3.7 Transfer switch test circuit.- A 30 ampere, 3 phase magnetic contactor with "on-off" keylock type pushbutton station shall be installed in a fused circuit as shown in Figure 1 for providing power to the transfer switch for test purposes. The coil circuit of the contactor shall be interlocked with the bypass switch so the contactor will drop open when the switch is returned to normal. A flasher shall be installed and connected to the test circuit to flash four 25 watt 120 volt remote indicating lamps whenever the contactor is closed to serve as a warning that the transfer switchboard is energized. The 4 - 25 watt lamps will be located in compartments of the automatic power

ment shall be open at the bottom for access to a cable trench beneath. Openings provided in the top over the bus compartment for inlet and outlet of the commercial power bus ducts shall be covered with an insulating material like "Benelex" or "Transite" with openings just large enough for the bus stubs. The bus compartment at the power inlet shall have a height of 61 3/8 inches above the bottom of the channels as shown in Figure 5. A mimic bus shall be shown on the front of the cabinet to illustrate the position of switching elements in the various circuits. Pressure sensitive tape will not be acceptable for forming the mimic bus.

The dimensions and component arrangement shall be as shown on Figure 5. except that the width of the cabinet (102 in.) may be less and the internal buswork may be modified as necessary to accommodate the switches and circuit breakers used. The barrier line shown on Figure 5 shall be retained.

An insulating barrier shall be provided which can be inserted in supports such as side channels at the barrier line to electrically separate the upper part of the switchboard from the lower part when switches "4", "5", aux 1 and aux 2 are open. A vertical barrier shall also be provided for separating "3", "4" and aux 2 from "2", "5" and aux 1, for maintenance purposes. The rear doors shall be split at the barrier line so the upper and lower parts can be operated independently.

Push buttons, auxiliary switches and pilot lights shall be mounted on the front of the cabinet. Space for the installation of two 1200 ampere auxiliary circuit breakers (3.6) shall be provided in the cabinet and shall be complete with all the necessary hardware, bus work, and stationary stabs to receive drawout frames. Openings in the front of the cabinet shall be provided with suitable cover when the 1200 ampere circuit breakers are not called for. An opening fitted with a removable cover, shall be provided in the top of the cabinet for entrance of the 3 six hundred MCM per phase cables connecting to each of the 1200 ampere circuit breakers. Terminal blocks for connection of the various external control circuits shall be located together in an appropriate place near the rear of the cabinet, and may be one continuous block. They shall be positioned so that the external leads may be brought in from above or below.

**3.9 Buses.-** Copper buses shall extend through the cabinet connecting the various switches and circuit breakers in accordance with NEMA Standard SG5. The bus bars shall meet the requirements of Federal Specification QQ-B-825. Phase identification shall be shown on all buses. The bus system and ampere ratings are shown on Figures 1 and 5. The joints and all tap connections

of the 1200 ampere circuit breakers shall be connected with lugs to receive 3 six hundred MCM cables per phase through the top opening required in 3.8 as well as 3 six hundred MCM cables to lugs which shall be provided on the neutral bus. Adequate space shall be provided for running all of the above mentioned cables.

3.10 Relays.- Relays shall not be used in the bypass switchboard control circuits.

3.11 Pilot lights.- Six pilot lights shall be installed on the front of the cabinet. Three of these shall be white and energized from commercial power to show that all three phases are energized. One light shall be green and energized when the bypass switch is in the normal position (switches 1, 2 and 3 closed; 4 and 5 open), one light shall be red and energized when the bypass switch is in the bypass position (switches 1, 2 and 3 open; 4 and 5 closed), and one light shall be blue and energized when the switches are in the bypass position and the test circuit contactor coil is energized (both red and blue lamps would be lighted). The red and green pilot lights shall be energized by the action of the main switches to eliminate false pilot light indications.

3.13 Wiring diagram.- A complete electrical schematic diagram and a connection diagram of the bypass switchboard wiring shall be furnished and permanently mounted on the inside of the front or rear door depending on which gives more access to the control circuitry. The diagrams shall be black lines on white background produced by printing or photographic methods enclosed between two 0.015 inch minimum thickness of clear plastic sheet or the diagram may be reproduced on white plastic and covered with clear bonded plastic. All leads shall be identified on the connection diagram. Electrical devices shall be identified in accordance with American standard device function numbers, USA C 37.2. The printed material shall be large enough to be easily read in the mounted position.

3.14 Identification.- A nameplate conforming to Drawing No. B-21216 shall be attached to the front of the cabinet near the top. Serial numbers will be assigned by the Contracting Officer. The BYPASS and NORMAL positions of the control switch or pushbuttons shall be clearly labeled with metal or plastic plates secured to the front of the cabinet with metal fasteners. Also, the pushbutton switch (3.7) shall be marked "Control Test", and the ON and OFF position shown. All controls and indicator devices shall be



3.16 Instruction books.- Instruction books shall be provided in accordance with Specification FAA-D-2160. If both Type I and Type II equipments are ordered, all descriptive data, photographs, drawings, etc. shall be included for both types of switchboard. A statement that one type is the reverse of the other will not be acceptable.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection.- Each completed bypass switchboard will be inspected at the contractor's plant by a representative of the Government in accordance with the requirements of FAA-STD-013 Quality Control Program Requirements. He will visually inspect the equipment to determine that it meets the physical requirements of the specification, and witness tests, performed by the contractor, to demonstrate compliance with the following performance requirements:

- Contact sequencing and other requirements of paragraph 3.3.3
- Operation of pilot lights, paragraph 3.11
- Operation of transfer switch test circuit, paragraph 3.7
- Operation of interlocks, paragraph 3.5
- Dielectric Test per SG5 - 4.09
- Temperature Rise Test per SG5 - 3.02
- Demonstrate compliance with maintainability requirements of par. 3.1.4
- Endurance Test - shall be performed on the first unit of each contract, paragraph 4.1.1

The contractor shall provide the 48 volt DC source for operation of the switchboard and any other test equipment needed to carry out the prescribed tests. The contractor also shall furnish the inspector with a certified circuit breaker test report for each circuit breaker with overload protection installed showing that the breakers have been tested and the trips set at the rating specified.

4.1.1 Endurance test.- The bypass switchboard shall be operated in each direction 120 times within a two hour period with rated voltage on the board and lamps connected in such a way that the lamps will indicate whether the switchboard is working properly. No repairs or maintenance shall be

5.2 Preservation, packaging and packing.- The preservation, packaging and packing shall be level A, B or C as specified in the procurement document and shall be in accordance with MIL-E-17555.

5.3 Marking.- All unit, intermediate, and shipping containers shall be marked in accordance with MIL-STD-129.

## 6. NOTES

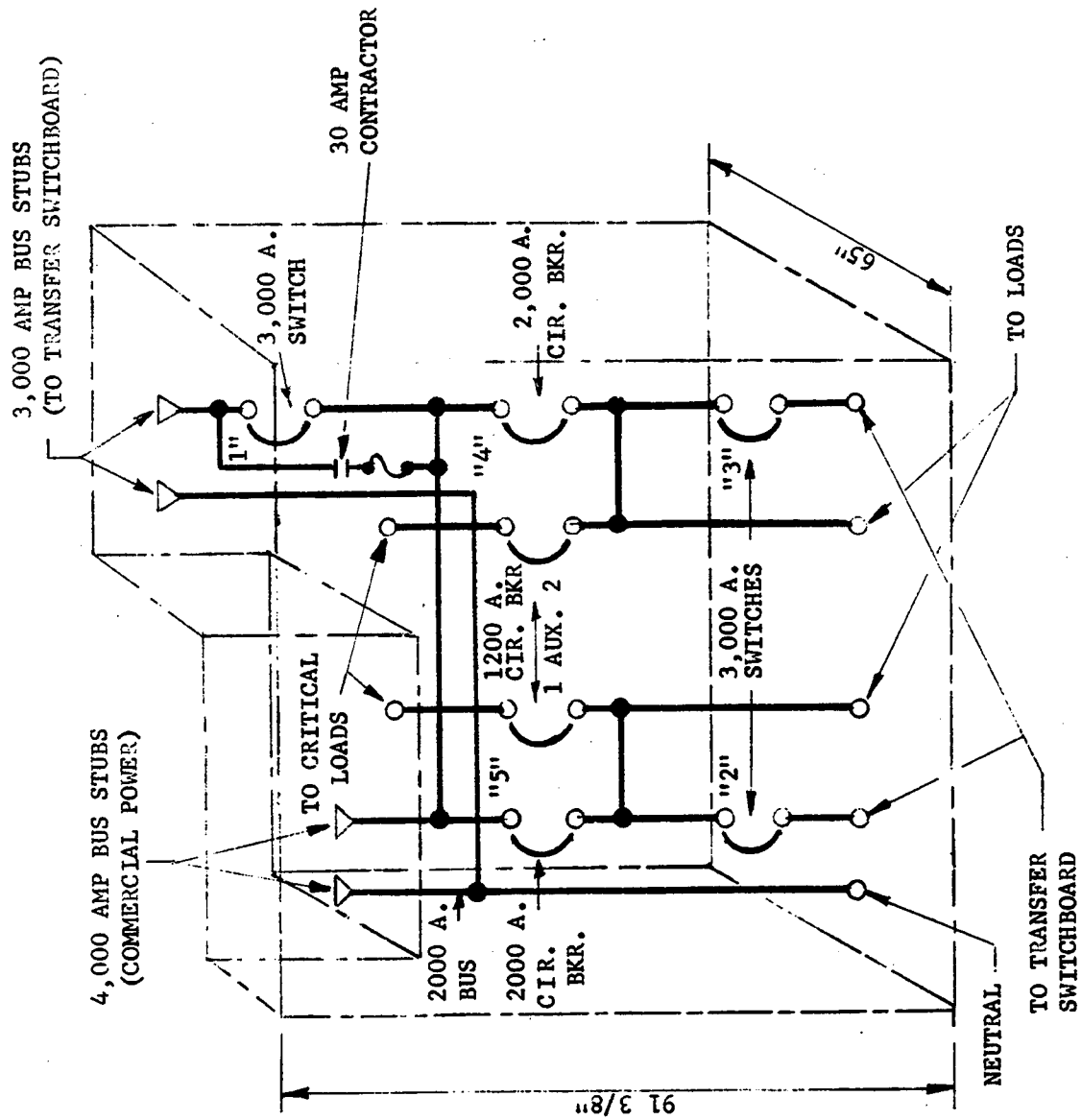
"6.1 Note on information items.- The contents of this Section 6 are only for the information of the initiator of the procurement request and are not a part of the requirements of this specification. They are not contract requirements nor binding on either the Government or the contractor. In order for these terms to become a part of the resulting contract, they must be specifically incorporated in the schedule of the contract. Any reliance placed by the contractor on the information in these subparagraphs is wholly at the contractor's own risk."

### 6.2 Ordering data

- a. Specify type (1.2)
- b. Specify auxiliary circuit breakers (3.6)
- c. Assign serial numbers (3.14)
- d. Specify quantity of additional instruction books (3.16)
- e. Specify packing level (5.2)

\* \* \* \* \*

FOR FIGURES 1 TO 5, SEE PAGES 11 TO 15  
ATTACHMENT: Drawing B-21216 follows Page 15.



NO SCALE

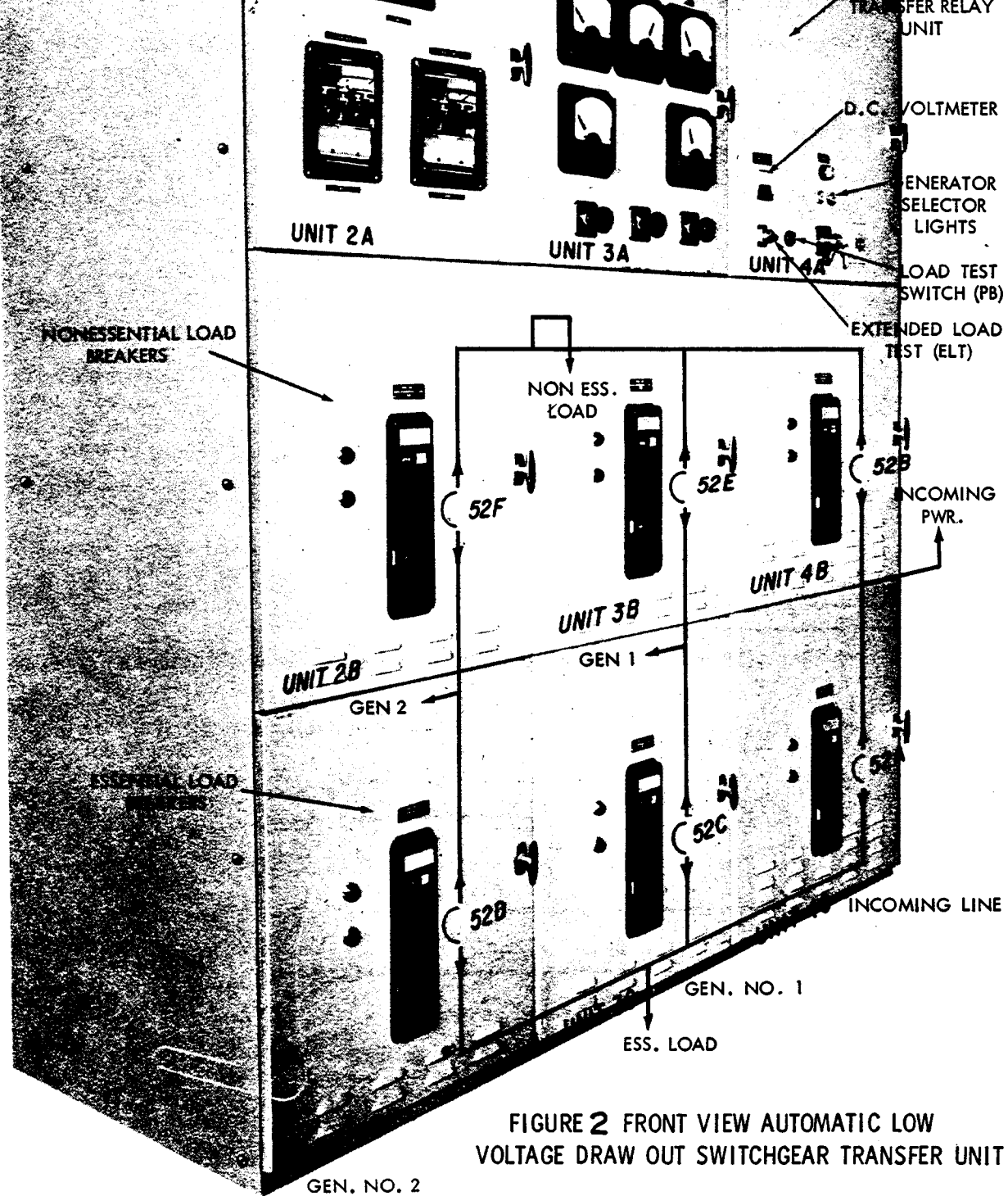
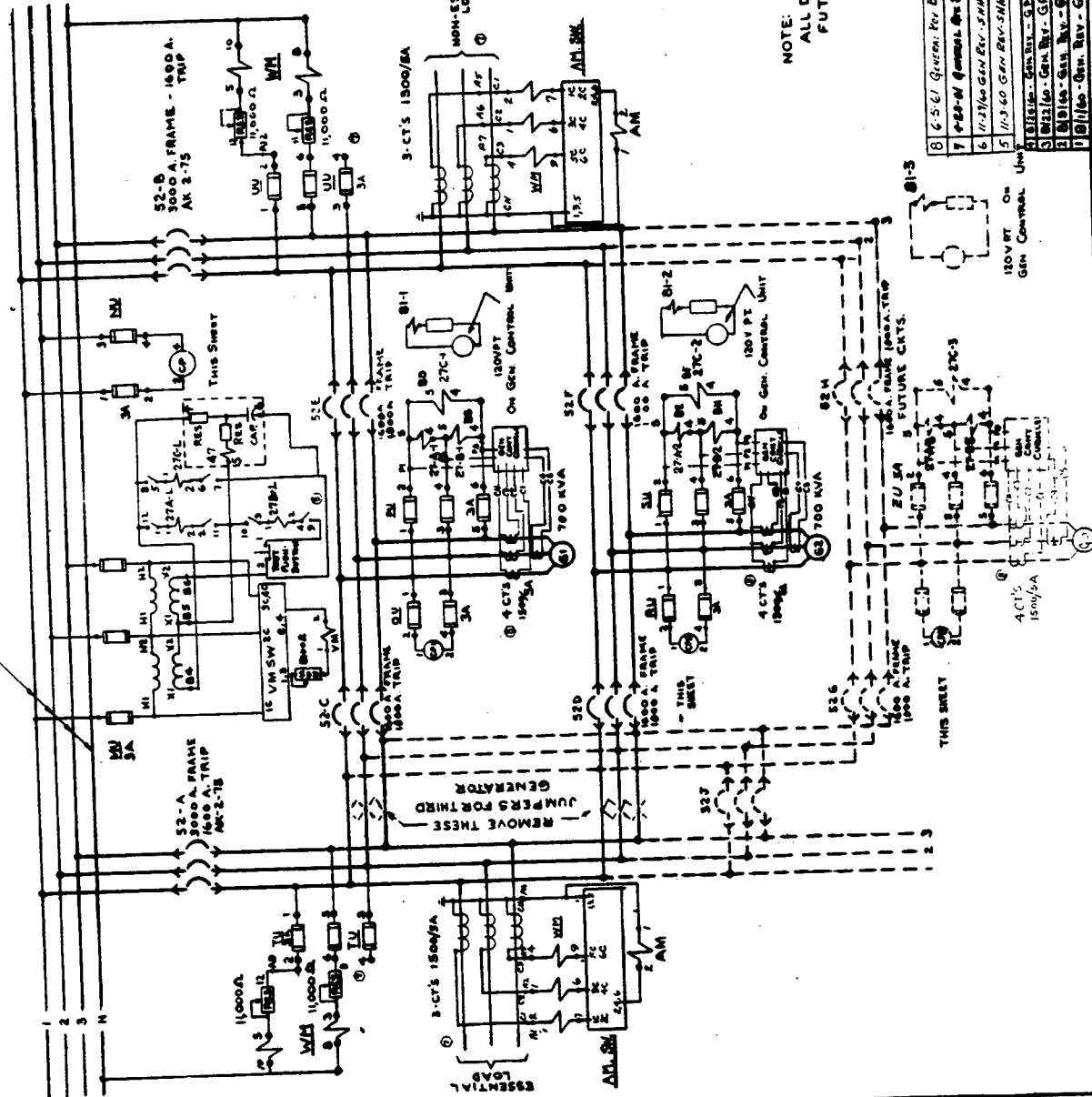


FIGURE 2 FRONT VIEW AUTOMATIC LOW VOLTAGE DRAW OUT SWITCHGEAR TRANSFER UNIT



# POWER CIRCUITS

4000A - 3P-4W-480V-60CYCLE BUS



NOTE: ALL DOTTED LINES ARE FUTURE CONNECTIONS

FIGURE 1  
AUTOMATIC SWITCH

REV.	DATE	BY	CHKD.	DESCRIPTION
1	11/1/50	GEN. REV.	SAH	11/1/50 GEN. REV. SAH
2	11/1/50	GEN. REV.	SAH	11/1/50 GEN. REV. SAH
3	11/1/50	GEN. REV.	SAH	11/1/50 GEN. REV. SAH
4	11/1/50	GEN. REV.	SAH	11/1/50 GEN. REV. SAH
5	11/1/50	GEN. REV.	SAH	11/1/50 GEN. REV. SAH
6	11/1/50	GEN. REV.	SAH	11/1/50 GEN. REV. SAH
7	11/1/50	GEN. REV.	SAH	11/1/50 GEN. REV. SAH
8	11/1/50	GEN. REV.	SAH	11/1/50 GEN. REV. SAH

120V PT. ON GEN. CONTROL UNIT  
4 CT'S 1500/5A  
120V PT. ON GEN. CONTROL UNIT  
4 CT'S 1500/5A



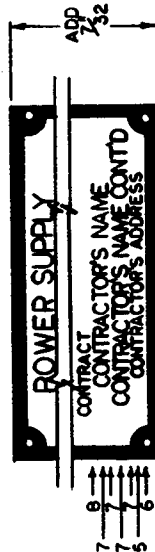




SIZES

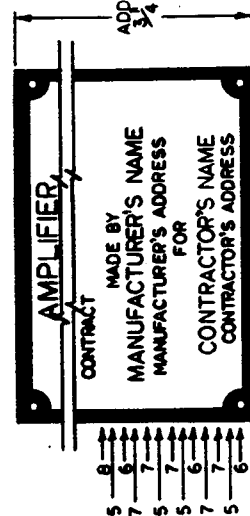


**SINGLE-LINE EQUIPMENT TITLE AND CONTRACTOR'S NAME;  
NO SUB-CONTRACTOR**



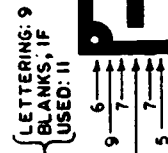
## TWO LINES FOR CONTRACTOR'S NAME

# INCREASE HEIGHT OF BASIC DESIGN BY 2<sup>1/2</sup>"



**EQUIPMENT MADE BY SUB-CONTRACTOR**

**INCREASE HEIGHT OF BASIC DESIGN BY  $\frac{3}{4}$ "**



## TWO-LINE EQUIPMENT TITLE

**INCREASE HEIGHT OF BASIC DESIGN BY  $\frac{1}{4}$ "**

**NOTES:**

1. ACCEPTABLE MATERIALS:  
0.03 INCH MIN. ALUMINUM WITH OIL RESISTANT FINISH (PROHIBITED ON ENGINE GENERATOR OUT OF DOORS),  
OR 0.03 INCH NICKEL SILVER (AN ANTI CORROSION PROCESS FOR BOTH OF ABOVE);  
OR 0.02 INCH MINIMUM PHOTOSENSITIVE COATING PROCESSED FOR WHITE METAL BACKGROUND; PHOTOSENSITIVE COATING IMBEDDED WITHIN THE OXIDE LAYER BY CHEMICAL TREATMENT ON ENGINE GENERATORS).
2. SERIAL NUMBER/ENGRAVE OR DIE STAMPING USED FOR RATING DATA (SEE TWO)
3. IF NO CONTRACT NUMBER, SUBSTITUTE NAMEPLATE SIZE MAY BE REDUCED WHEN DIMENSIONS AND LETTER SIZES ARE PROPORTIONALLY REDUCED TO MAINTAIN PROPORTION, EXCEPT THAT HOLE DIAMETER AND MARGINAL RADII SHALL REMAIN UNCHANGED.
4. EQUIPMENT TITLE, TYPE DESIGNATION/TITLE FURNISHED BY GOV'T. AFTER AWARD
5. TOLERANCE ON DIMENSIONS ±0.010 TO-HOLE SPACING ±0.005 INCH.
6. SUBCONTRACTOR NAME/PLATE DESIGNATED BY SUBCONTRACTOR IS MANUFACTURED BY SUBCONTRACTOR
7. CHARACTER GROUPS TO BE CENTERED
8. CONDENSED TYPE MAY BE USED.

[illegible]

